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THEORY BACKGROUND FOR STUDY OF BART'S IMPACTS ON HUMAN PERCEPTION AND RESPONSE

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The BART Impact Program is a comprehensive, policy-oriented study and evaluation of the impacts of the San Francisco Bay Area's new rapid transit system (BART).

The program is being conducted by the Metropolitan Transportation Commission, a nine-county regional agency established by state law in 1970.

The program is financed by the U.S. Department of Transportation, the U.S. Department of Housing and Urban Development, and the California Department of Transportation. Management of the Federally-funded portion of the program is vested in the U.S. Department of Transportation.

The BART Impact Program covers the entire range of potential rapid transit impacts, including impacts on traffic flow, travel behavior, land use and urban development, the environment, the regional economy, social institutions and life styles, and public policy. The incidence of these impacts on population groups, local areas, and economic sectors will be measured and analyzed. The benefits of BART, and their distribution, will be weighed against the negative impacts and costs of the system in an objective evaluation of the contribution that the rapid transit investment makes toward meeting the needs and objectives of this metropolitan area and all of its people.

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BART IMPACT PROGRAM

THEORY BACKGROUND FOR STUDY OF BART'S IMPACTS ON HUMAN PERCEPTION AND RESPONSE

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This paper provides a review of behavioral science literature relevant to human perception and response. It outlines a possible strategy for the use of behavioral science theory: a conceptual model of the impact process is suggested which includes the element of human response and its determinants. An extensive bibliography is also included.

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PREFACE

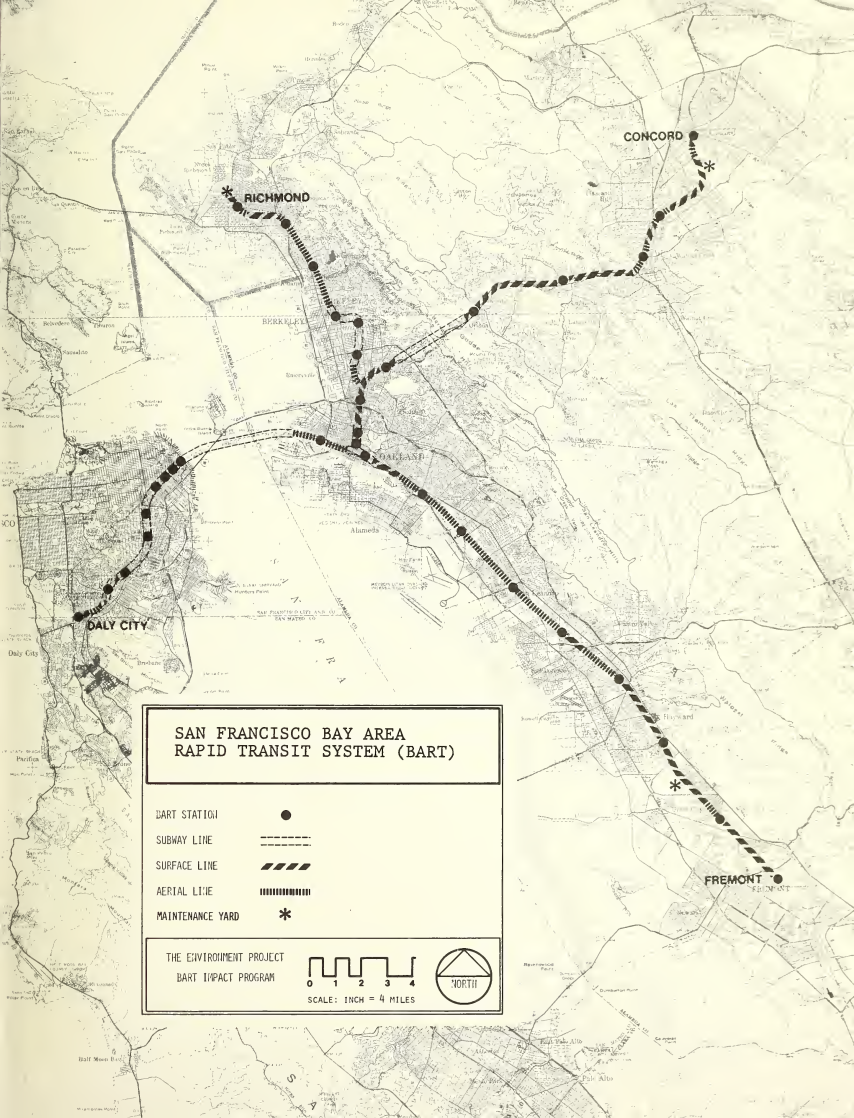
The BART Impact Program (BIP) is a comprehensive, policy-oriented study and evaluation of the impacts of the new San Francisco Bay Area Rapid Transit System (BART). The system's alignment and configuration are shown on the page following this preface. The BART Impact Program covers the entire range of potential rapid transit impacts, with major projects covering impacts on traffic flow, travel behavior, land use and urban development, economics and finance, social institutions and life styles, public policy and the environment. The incidence of these impacts on population groups, local areas, and economic sectors is being measured and analyzed. The benefits of BART, and their distribution, are being weighed against the negative impacts and cost of the system in an objective evaluation of the contribution that the rapid transit investment makes toward meeting the needs and objectives of the Bay Area and all its people.

The Environment Project focuses on the effects of BART's physical presence on its surroundings. Environment is defined broadly to include five components: acoustic, atmospheric, natural, social and visual. Within each of these components the Environment Project will address two related phenomena:

- Direct and indirect physical effects upon the environment brought about by the BART system.

- Social and psychological consequences of these physical changes to the environment.

One of the main objectives of the Environment Project is to include the point of view of the lay public--those exposed to BART's environmental impacts--in its assessments of those impacts. This requires that the project identify the perceptions and behavioral response of those persons, and relate them to features of BART as distinct from other contributing causes. Such a task involves acknowledgement and review of the behavioral science literature, in order that the project can make use of relevant theory and research findings. This paper provides such a review for the benefit of BART Impact Program staff and other planners. It also outlines a possible strategy for the use of behavioral science theory: a conceptual model of the impact process is suggested which includes the element of human response and its determinants.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SUMMARY

One of the main objectives of the Environment Project is to include the point of view of the lay public--those exposed to BART's environmental impacts--in its assessments of those impacts. This requires that the project identify the perceptions and behavioral response of those persons, and relate them to features of BART as distinct from other contributing causes. Such a task involves acknowledgement and review of the behavioral science literature, in order that the project can make use of relevant theory and research findings. This paper provides such a review for the benefit of BART Impact Program staff and other planners. It also outlines a possible strategy for the use of behavioral science theory: a conceptual model of the impact process is suggested which includes the element of human response and its determinants.

The paper first describes and critiques extant theories of man-environment interaction. This includes phenomenological, behavioristic, Gestalt (or field), functionalist, and transactional approaches. It is concluded that the available theories are not well adapted to use in a pragmatic study of BART's impacts; however, several key concepts are identified. From these a general model is suggested, based on the conception of the impact of BART as a function of other characteristics of the environment and its residents as well as those of BART itself.

The main body of the paper elaborates on this concept to include the roles and effects of variables intervening between BART attributes (initial causes of impact or independent variables) and human response or behavior (the dependent variable). These include the physical environmental context, the population context, and aspects of the individual. This discussion includes extensive references to and explanation of the psychological literature relevant to each point, and is a useful introduction to many key behavioral concepts for planners.

A more specific "practical preliminary model" is then presented as a derivation of the preceding investigation. For policy relevance, the independent variables are physical BART attributes which produce stimuli measurable in terms of the human senses. These are moderated by the environmental context as well as supra-personal and behavior-setting variables (e.g., activity affected, crowding, surrounding population characteristics, etc.) and individual characteristics such as age, health, ethnicity, and socio-economic status. The dependent variables are indicators of attitude such as behavior, behavior traces and self-reported feelings.

The paper concludes with proposal of a stepwise use of analysis of variance as the basic analytical tool in specification of the model. An extensive bibliography is appended.

I. INTRODUCTION[1]

Rationale for this Paper

This paper is a background document for the Environment Project, a part of the overall BART Impact Program which will assess the effects of the new rapid transit system (BART) upon the San Francisco Bay Area. Environmental impact studies have tended to rely upon experts' judgments to identify gains and losses in environmental quality. However, it has been demonstrated in several contexts that experts and the lay public do not always agree. Lansing and Marans (1969) concluded that planners and their clients do not share the same concepts of environmental quality. Carp (1966) found that evaluations of a residential environment for the old differed between designers, staff and residents; indeed, some design features intended to make the environment attractive and convenient for elderly residents were experienced by them as unusually inconvenient. This was no temporary matter of becoming accustomed to innovations; negative evaluations persisted (Carp, 1976). In regard to water pollution, Mitchell (1971) concluded: "Empirical evidence suggests that significant differences do exist between the professional decision-makers and the lay public regarding the nature of the .....problem." Such studies suggest that one imperative component of understanding BART's impact is its effects upon the environment from the perspective of Bay Area residents.

The "human response" element is an integral part of the whole and not, as preparation of this paper might suggest, a separate substudy. The present paper is necessary only because, as usual, inclusion of "real people" greatly compounds the complexities. This paper provides a background from the literature of behavioral science in order that the study design can make use of relevant research findings and theory, and it suggests a strategy for doing so.

Purpose of the Environment Project

Briefly stated, the purpose of the Environment Project is to measure BART's impact upon environmental quality in terms of the behavior and experience of people who live, work, attend school and play near the rapid transit system.

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[1] This paper was undertaken as part of the overall effort in developing the Research Plan for the Environment Project. The work was done by Frances M. Carp, Ph. D., consultant to the Gruen Associates/De Leuw, Cather team.

This must be done in a way which will produce practical local application such as:

1. Suggesting design and/or management changes in BART,
2. Suggesting improvements in extensions of BART, and
3. Informing zoning policy in areas contiguous to elements of the system and/or those which provide access to it.

In addition, it is essential that the work be conducted in such a way as to maximize the utility of its findings to other metropolitan areas.

Moreover, this study is, by its nature, pioneering into a relatively uncharted area of man-environment interaction. Therefore, some consideration should be given in its design to (1) probable implications for more broadly defined research into environmental impact, and (2) possible contributions to the knowledge base of some of the more traditional disciplines. However, the primary relationships with basic research and with theory must be defined in terms of their utility for practical purposes of policy design and management.

II. THEORY BASE

Theories of Person-Environment Interaction

The first task for this resource paper, then, is to review theories in terms of their relevance and practical utility for the study. Psychological theories of person-environment interaction commonly are categorized into five types:

1. Phenomenological
2. Stimulus-response or behavioristic
3. Gestalt or field
4. Functional
5. Transactional

In phenomenological approaches, the subject matter is subjective experience and the primary method is introspection as defined by Morgan and King (1966): "A method of psychological experimentation in which a subject is presented with some stimulus, such as a colored light, and asked to give a detailed report of his sensations; seldom used at the present time." Ittelson (1960) has demonstrated the inevitable circularity of introspection with regard to perception, and this method is equally circular in the investigation of any

other psychological function. The crucial impotence of phenomenological theories for the present purpose is that they are totally preoccupied with processes "inside the skin" of the person; their results bear no useful relationship to the external world of reality (Wohlwill, 1974; Lawton, 1975), and, therefore, none to BART as it exists in that real world.

Stimulus-response or behavioristic theories have the significant advantage of dealing with stimuli in terms of environmental variables in "the world out there." However, these theories are inadequate to the present task in two ways: 1) they limit response to external behavior and do not include the experience of the responding person, and 2) they have a mechanistic view of the respondent which is generally held to be outmoded. As Merleau-Ponty (1967) points out: "The organism cannot properly be compared to a keyboard on which external stimuli would play and in which their proper form would be delineated for the simple reason that the organism contributes to the constitution of the form." Similarly, according to Ittelson, Proshansky, Rivlin and Winkel (1974): "...environmental psychology is not a theory of determinism. It sees man not as a passive product of his environment, but as a goal-directed being who acts upon his environment and who in turn is influenced by it." Hall and Lindzey (1957) comment:

> The importance of the external world is both as a source of disturbance with which the individual must cope and as a source of supplies by means of which the organism fulfills its destiny. That is, the environment intrudes upon the organism by stimulating or over-stimulating it so that the equilibrium is upset, while on the other hand the upset organism searches in the environment for what it needs in order to equalize the inner tension. In other words, there is an interaction between the organism and the environment.

A Gestalt or field theory is "a type of psychological theory that stresses the importance of interactions between events in the person's environment" (Morgan and King, 1966). It is obvious that such interactions are highly relevant to studies of BART's impact. However, Gestalt theories generally are stated at such global levels and in terms of such generalized variables that they provide inadequate bases for deriving testable hypotheses. In addition, despite the emphasis upon "wholeness", any particular Gestalt theory tends to be preoccupied with only one function. For example, Lewin's (1936, 1951) is a theory of behavior, not perception or cognition, while Koffka (1935) really deals only with perception.

Functionalism is "a viewpoint taking the middle course among introspection, behaviorism and gestalt psychology. Functionalists propose that all activities serving some adaptive function, including both behavior and experience, be studied by psychologists" (Morgan and King, 1966).

Transactionalism is the emerging posture toward investigation of person-environment relationships. According to Pervin (1974):

> There are three levels in the development of knowledge and the history of science.
>
> The first level is that of self-action and involves regarding objects as behaving under their own power. The second level is that of interaction and involves objects in a causal interconnection of one object acting upon the other. Finally, there is the level of process transaction which involves objects relating to one another within a system. In this third level, organism and environment influence one another as part of a total transactional field. Essentially, then, transactionalism has three properties: a) Each part of the system has no independence outside the other parts of the system or the system as a whole. b) One part of the system is not acted upon by another part, but instead there is a constant reciprocal relationship. There are not cause-effect relationships but transactions. c) Action in any part of the system has consequences for other parts of the system.

Transactionalism combines the interactionism of field theories with the functionalist view of the adaptive role of the interaction, and it encompasses the system analysis concept of feedback.[1] "Observation of this general (transactional) type sees man-in-action not as something radically set over against an environing world nor yet as merely action 'in' a world but as action of and by the world in which the man belongs as an integral constituent" (Dewey and Bentley, 1949).

> Neither a perception nor an object-as-perceived exists independent of the total life situation of which both perception and object are a part... The word transaction is used to label such a situation for the word carries the double implication that all parts of the situation contribute to this active participation, and do not appear as already existing entities that merely interact with each other without affecting their own identity. (Ittelson, 1960)

[1] Feedback: "The situation in which some aspect of the output regulates the state of the system" (Morgan and King, 1966).

Most leading thinkers in the field seem to agree with Pervin (1974): "What is clear...is that complex and future analyses will be of a transactional kind" in which, according to Ittelson, Proshansky, Rivlin and Winkel (1974): "A guiding principle...is what we have called the dynamic interchange between man and his milieu." This transactional viewpoint must, therefore, be accepted for the present purpose.

It is important to recognize, however, that transactionalism remains, to date, a viewpoint rather than a theory. Model building on this basis is in preliminary stages, and transactionalists still search for roots in existing theory systems from which they can advance. Again, Pervin (1974) seems to express the opinion of most would-be model builders when he writes:

> The two theories of personality which give greatest attention to the issue of individual-environment interaction are those of Lewin (1951) and Murray (1938). Lewin's behavior as a function of personality and environment, B=f (P,E) has often served as a model for later Lewinian research. Murray's theory is particularly noteworthy in that it provides for a classificatory scheme, has a model for the relationship between the individual and his environment, and distinguishes between the environment as it is (alpha press) and as it is perceived by the individual (beta press).

Limitations to Practical Application

The primary demand upon the study design is that it produce facts about BART, one element in the environment of the Bay Area, as a cause of particular human response and experience. At first glance, this would appear to be not only eminently desirable and reasonable, but also to be a prototypical problem for behavioral science. Therefore, the expectancy seems justified that theoretical frameworks would be detailed and procedural directions would abound with regard to physical stimuli.

Unfortunately, that is far from the case, as is immediately apparent when the requirement is made for information of practical consequence about the environmental element, BART. This, of course, is the heart of the study. In a sense, all behavioral science has been an effort to explicate the environment-behavior link. Even in the most phenomenological conceptions of behavior, causation is thought ultimately to be related to a world outside the person. However, only behaviorists have specified stimulus variables in terms of an environment external to the person, and this mainly in laboratory settings.

The physical environment has been very incompletely incorporated into the mainstream of behavioral science investigations--and, therefore, into its theory systems. This becomes all too obvious when an attempt is made to glean a theoretical background for a study such as this, whose findings must have implications for specifics of the real world. This inadequate attention to the physical environment has several causes and consequences.

1. Behavioral science has not been interested in the physical world. Explicitly in many cases and in even more, implicitly, behavioral science has been preoccupied with variations in behavior which can be attributed to factors other than those in the external world. Personal and social processes traditionally are the variables of interest. In regard to the physical environment, the behavioral or social-science investigator either assumes that it is sufficiently comparable from one situation to another to not matter, or he takes steps to "hold it constant" so that it cannot affect his results.

2. There is a strong tendency for behavioral science theorists to transform environmental stimuli into internal representations of the environment. This tendency began early: Lewin's concept of "life space" (1936), while implying a physical environment as referent, is in fact a phenomenological concept; the life space is entirely psychological and does not exist "out there" in the world of physical reality. The tendency has continued as theorists have struggled to postulate the "intervening variables" in the "black box" between stimulus and response.

   The tendency remains strong as is evidenced, for example, by the preoccupation of man-environment researchers with "environmental cognition." Such theoretical approaches actually are as ineffective in clarifying person-environment relationships as are those which simply ignore external realities (Wohlwill, 1974). Indeed, they may even more greatly retard progress for the very reason that they seem to be struggling with the person-environment issue, while actually the only "environment" with which they deal is the one inside the respondent's skin.

3. Within behavioral science, there is serious semantic confusion regarding the meaning of "environment." Not only is the label used for inner representations of external objects and events,

rather than for those objects and events themselves; in addition, the word "environment" has been applied to the physical, the social, and the organizational surround, and to various combinations of the three, with inadequate specification of the referent.

Development and personality theorists such as Freud, Allport, and Murphy often meant "interpersonal relationships" when they said "environment." Organizational theorists and sociologists refer to group processes, milieux, norms and cultural pressures as "environment," and do not specify the extent to which these "environmental" factors reflect social influences as contrasted with aspects of the physical setting. Even theorists who gave prominent place to "the environment"--including Lewin and Murray--made little attempt to differentiate its personal, social, and physical aspects.

4. Recent interest in the physical environment on the part of behavioral scientists may be token, only. Existing taxonomies, which ostensibly deal with the environment actually are largely social in nature. Sells (1963) has attempted the most complete taxonomy ("basic aspects of the total stimulus situation"). It is highly detailed in terms of personal and social stimuli (with a total of nearly 250 entries in these categories) but skimpy in its treatment of the physical environment, including only four "natural environment" classes: gravity, weather, terrain, and natural resources. Indik (1963) deals in depth with "environments for organizations" but, among over 300 entries, the only physical items are Sells' four natural environment classes.

5. "Environmental dimensions" are not necessarily physical. A number of investigators have sought higher order abstractions with which to contrast environments, or to express relationships among the many ways of dimensionalizing the domain. Disclaiming any attempt to be exhaustive or to reference each, Lawton (1975) lists some dimensions that have been suggested:

natural vs. man-made
large vs. small
crowded vs. sparse
stable vs. unstable
patterned vs. random
homogeneous vs. heterogeneous

complex vs. simple
redundant vs. limited
rich vs. impoverished
public vs. private
legible vs. illegible
controlled vs. autonomous
habitable vs. uninhabitable
supportive vs. demanding
novel vs. familiar

As Lawton points out, it is immediately apparent that many of these dimensions are not easily translated into truly environmental terms; some seem impossible of such translation. The categories above are listed roughly from physical to interactional. That is, external physical data are usually a sufficient basis on which to classify an environment as natural or man-made, but whether it is novel or familiar depends entirely on the person viewing it.

Defining Environment: A General Structure

Lawton concludes that the behavioral science literature suggests three levels of definitions for aspects of the physical environment: 1) the level of the phenomenal physical environment--the unique, idiosyncratic experience of a physical object by one person; 2) the level of the consensual physical environment--enough individuals experience the environmental item in a way sufficiently similar as to suggest convergence on the "real object", and 3) the level of the objective physical environment--as defined in terms of characteristics which can be measured in centimeters, grams, seconds, etc. Consequently, it may be said that the behavioral science literature suggests three types of "environmental definition" for BART: phenomenal BART, consensual BART, and physical BART.

III. A PROPOSED THEORETICAL MODEL

The Basic Equation

Following Pervin's recommendations, the theories of Lewin and Murray will be accepted as the basis for model development, but with the functionalist definition of behavior, and a transactional view of the person and the environment. In Lewinian terms, and defining all B terms in the functionalist manner to include experience as well as behavior, BART impact can be stated:

$$B_{BART} = B_1 - B_2$$

when

$$B_1 = f(P, E)$$

$$B_2 = f\left(P, E_{+BART}\right)$$

Obviously, in the transactional view, the various terms of interaction must be included. The basic formula becomes B=f(P, E, PxE) and the "BART equation" must be expanded to include interactions between and among all P and E components. It is necessary, now, to define the components of this equation with greater specificity.

Environmental Components (E)

Independent Variables: BART Attributes

Wohlwill (1974) has argued persuasively that unless "the environment out there" is used as a standard, there is no adequate basis for interpreting individual differences in cognition of the environment. The argument for inclusion of the "real world" external to personal perceptions is even more cogent when the primary goal of a study is assessment of structural and operational factors in the real world, including recommendation of modifications.

It is essential--if the study is to have practical utility--to develop a model which does not sidestep the "real world" but which, rather, incorporates objective attributes of BART as it exists and operates in the objective physical world. The Lewinian equation is used, therefore, with an ecological rather than a psychological connotation. That is, the independent variable[1] must in every case be an element in the structure (such as degree of track curvature) or operation (such as train speed) of BART. These structural and operational characteristics of the rapid transit system which comprise the pool of potential independent variables are termed, for purposes of this paper, BART attributes.

[1] Independent variable: "The variable that may be selected or changed by the experimenter and is responsible for changes in the dependent variable" (Morgan and King, 1966).

By no means is every structural or operational characteristic relevant to this particular part of the study, but only those characteristics which are capable of stimulating the sensory end-organs of persons in the vicinity of the rapid transit system. In order that the results shall have direct, practical implications regarding specifics of the structure and operation of BART, only BART attributes may be candidates for independent variable status. However, in order to assess the likelihood that these attributes will have impact upon persons, the intermediary step must be taken of plotting their psychological reality in terms of human sensory equipment.

For the moment, the model will be pursued in terms of the typical or normal human sensorium, and "BART stimuli" will be derived from "BART attributes" by considering the implication of the latter in terms of their production of physical "signals" (such as light waves or sound waves) which the normal human organism can detect through the primary sensory processes of vision, audition, olfaction, and somesthesis. (Gustation and kinesthesis seem irrelevant to this study, though the latter will be highly relevant to investigation of BART's impact upon travelers.)

Any given "BART stimulus" does not necessarily bear a one-to-one relationship with a particular "BART attribute." Sound may be taken as an example. The human organism perceives sound in terms of loudness, pitch and periodicity. The relevant BART stimuli are, respectively, decibels, frequency and time pattern, all of which can be measured instrumentally. It is, therefore, fairly straightforward to relate these "BART stimuli" to human response. However, any given "BART stimulus" may be determined by several "BART attributes." For example, decibel level and sound-wave frequency may be affected by train speed, track curvature, track elevation, track maintenance, and wheel wear. "BART attributes" interact with each other in the production of "BART stimuli" and, if implications are to be drawn for understanding the rapid transit system as it impacts the human population, the exact nature of these interactions must be determined.

An appropriate strategy is: 1) during the first phase of the study to a) roster all potential "BART stimuli," b) take instrumental measures sufficient to map the variance and locational distribution of each, c) document the causal relationships of "BART attributes" to each "BART stimulus," and d) collect and devise instruments for the subsequent measurement of human response to each "BART stimulus." This Phase I work will provide a sound basis for the development of a sampling strategy so that, 2) during the second phase of the study, human response data can be collected with specific relevance to "BART attributes."

In terms of human response, the effective value of any "BART stimulus" is the level of the instrumental or objective measurement of that variable "at the skin," so to speak, of the respondent. This requires, of course, that objective recording and human response be collected concurrently in time and space (or adequate rationale presented for some other guarantee of congruence).

The Physical Environmental Context

Also required, during Phase I, is the specification of ways in which attributes of the physical environment in which BART is embedded may change the value of any "BART stimulus." To use again the example of sound: the decibel level of BART train noise will be reduced by the interposition of a high land contour or other barrier (Schultz and McMahon, 1971) and may be amplified by surrounding hills. During Phase I, the effects of physical attributes of the environment upon each of the "BART stimuli" must be explored and documented. Upon completion of the study, one line of recommendations may well deal not with "BART attributes", but with addition of barriers around elements of the BART system, and with locational considerations for extensions of BART or for new rapid transit systems.

During the Phase I analysis of the effects of physical environmental factors upon BART stimuli, it is likewise necessary to clarify the interactions between "BART attributes" and characteristics of the physical environment. This is of particular importance in the selection of control sites and other efforts to guard against attributing to BART the effects of other environmental characteristics which tend to be correlated with "BART attributes." For example, it is possible that what in the pre-BART data is called the "configuration" of BART (elevated-underground) is partly determined by, and therefore related to, characteristics of the surrounding terrain. If so, care must be taken not to confound terrain effects with those of the BART attribute.

The Population Context or Supra-personal Environment

In order to complete what Barker (1968) terms the ecological environment ("the objective, pre-perceptual context of behavior; the real-life settings within which people behave"), and what Koffka (1935) calls the geographical environment ("the objective physical and social environment") as distinct from the behavioral environment ("the environment as perceived and reacted to"), it is necessary also to discuss characteristics of the population or what Lawton (1970) labels "supra-personal environment."

Like the physical context, the supra-personal environment is "outside the skin" of the person. However, it plays a different role in the model. The population context, as such, does not affect a "BART stimulus." (For example, for the same speed, curvature, maintenance, etc. the decibel level does not vary according to the age or income distribution of the local population.) The possibility that perceptions regarding BART train noise vary according to such population characteristics is a matter for a subsequent section of this paper. Both physical and population contexts, and interactions between them will play roles at a later stage in description of the model, as elements in the "field" or "ground" against which a "BART stimulus" may be perceived as "figure", and as components in the personal vulnerability/competence vs. environmental press interaction.

In this section, attention is focused on two other roles of the supra-personal environment. One matter of concern is interactions between "BART attributes" and population characteristics which may tend to confound conclusions regarding BART's impact. Clearly, "BART attributes" are not independent of population characteristics any more than they are independent of physical environmental characteristics. For example, before BART trains ran (and probably before the rapid transit system was built), old people and poor people probably tended to be concentrated near the right-of-way. The direction of causality is by no means always clear. For example, the original design was changed and BART was put underground in Berkeley. One important issue is to identify BART attribute-population characteristic interrelationships in order to take them into account in the selection of control sites and otherwide "hold them constant" so that they do not contaminate conclusions regarding BART's impact.

In addition, population characteristics are real aspects of the environment and may well influence reactions to BART.

> The principle that behavior represents the interaction of the individual and the environment situation implies that the total variance of any response can be accounted for only in part by individual differences in characteristics of the participating persons: it depends also on the stimulus characteristics of the environmental situation (both physical and social) and in part on the interactions between aspects of each. (Sells, 1963)

> Various characteristics of the individuals inhabiting a particular environment--average age, ability level, socioeconomic background, educational attainment, and the like--may be considered situational variables in that they partially define relevant characteristics of the environment. (Sells, 1963)

This general idea is based on Linton's suggestion (1945) that most of the social and cultural environment is transmitted through other people.

> The character of an environment is dependent on the nature of its members, and its dominant features on their typical characteristics. If we know what kind of people make up a group, then we can infer the climate that group creates. (Moos, 1974)

> Furthermore, the broadly social (as contrasted to physical) environment is not only an aspect of the situation external to the behaving individual, but its stimulus value is determined by intertwining physical factors. (Wohlwill, 1974)

In the present attempt to escape from the behavioral-science trap of failing to pay genuine attention to physical reality, it is equally important not to "throw the baby out with the bath" and fail to pay proper attention to the social context. However, population variables, like physical variables, are treated in terms of external reality and objective measurement, not as phenomenological "within the person" variables, in the present conceptualization. Census-type data comprise this portion of the model. The population context is Koffka's (1935) "geographical environment" (the environment as it exists) rather than his "behavioral environment" (the environment as the person experiences it). So far, the model deals with external reality, not with Lewin's (1936) "life space." According to Koffka (1935):

> The person is a component of both these environments, and his behavior and experience reflect the balance of influences that result from the interaction of the two worlds, the world as it exists and the world as he perceives it.

Summary

To this point, the model provides a framework for stating specific main hypotheses about BART attributes and clearly testing them with instrumental and objective dependent variables (BART stimuli). Furthermore, it provides a basis for analyzing BART stimuli (its potentials for affecting human response) as they interact with other parameters of the physical and supra-personal environments.

These dependent variables (BART stimuli) now become, in effect, the independent variables for subsequent steps in the model, when the personal element is incorporated.

Personal Components (P)

Following Lewin (1936), "the person is to be represented as a connected region which is separated from the environment by a Jordan curve. Within this region there are part regions. One can begin by distinguishing as such parts the inner-personal regions from the motor and perceptual region. The motor and perceptual region has the position of a boundary zone between the inner-personal regions and the environment (E)"

Perception[1]

The only avenue through which BART can have impact upon the person is that of perception: "The way an observer relates to his environment--the way in which information is gathered and interpreted" (Murch, 1973). According to Ittelson (1960), the three major characteristics of perception can be summarized by saying that "perceiving is that part of the process of living by which each one of us from his own particular point of view creates for himself the world in which he has his life's experiences and through which he strives to gain his satisfactions."

"Environmental perception does not spring directly from the objective properties of the world out there, but rather, from that world transformed into a psychological environment by a perceiving and organizing organism. In a very general sense of the term, it is an essentially creative process, actively carried out by the individual who is himself immersed in the perceptual situation. The adequacy of these perceptions is assessed not by comparing them with some hypothetically independent environment, but rather by their utility in aiding the individual in achieving his own personal and social goals" (Ittelson, Proshansky, Rivlin and Winkel, 1974).

> The external influence...is not the mechanical cause of the reaction of the organism, but is the stimulus which prompts the response. The response is mainly determined by the intrinsic tendencies of the organism... The external condition which prompts the response acts not by its properties as such but by its properties relative to the organism. The stimulus quality of an object is a relational property, that is, one which the object derives from its relation to the organism. (Angyal, 1941)

[1] This section of the paper presents "perception" in its technical meaning within psychology, which is different from its everyday usage.

Perception of "BART stimuli" will occur within the context of the psychological environment or Lewinian "life space" and according to the laws of perception. How sensory input is perceived is determined by:

a) the input,
b) the principles of figure-ground organization,
c) the concepts which have been previously associated with the input,
d) the set of the receiver,
e) on-going brain activity in the perceiver, and
f) the motives of the perceiver. (McKeachie and Doyle, 1966)

The input has been defined: a particular "BART stimulus" as measured in instrumental or other objective terms. A primary task of the research is to ascertain the extent to which perceptual processes transmit accurately or distort this objective, physical index.

The principles of figure-ground organization. The model at this point refers back to the physical context, but in a new way. The likelihood that a "BART stimulus" will be perceived is due not only to the strength of that BART stimulus but also to its recognizability as "figure" against the back "ground," in Gestalt terms (Koffka, 1935).

The same phenomenon, in terms of psychophysics, is the difference threshold or just noticeable difference (j.n.d.): "The minimum amount of added stimulation (given an initial level of stimulation) that will be detected by the observer" (McKeachie and Doyle, 1966). And "the amount of change that will be noticed (a just-noticeable difference) depends on the level of stimulation to which it is being compared" (ibid).

A similar concept is masking. Defined in terms of auditory perception masking is: "the deleterious effect of one sound on a person's ability to hear other sounds simultaneously" (Morgan and King, 1966). The principle applies similarly to other sensory modalities.

The implication of these various but related concepts, for present purposes, is that perception of a "BART stimulus" will depend not only upon the strength of that stimulus but also upon the sharpness or clarity with which it stands out against the local background stimulus field. For example, BART train noise of identical sound quality will be differently perceived in areas with low vs. high noise climates, aside from BART.

Concepts previously associated with the input will also determine how sensory input is perceived. The process by which input is identified with a concept is called categorization. "One of the basic processes determining how we perceive a given stimulus is categorization. We relate stimuli to concepts we have formed in the past. The resultant percept will depend on four factors: the various concept strengths associated with the stimulus, the concept associations of other stimuli in the situation or of immediately preceding situation (set), ongoing brain activity, and current motivation. The interaction of these factors produces definite categorization in some cases, tentative categorization in others, and the discomfort of ambiguity in still others. The categorization is either confirmed or unconfirmed by subsequent experiences" (McKeachie and Doyle, 1966).

Initial categorizations of BART inputs will be made on the basis of apparent similarity to familar concepts, and initial perceptions of BART will be colored by the concepts attached to that category. For example, prior to its operation, some Bay Area residents expected BART to be like a monorail, others expected it to be more like a commuter train, and still others thought BART would be like a subway. Attitudes tended to be markedly different toward monorails, commuter trains and subways. Therefore, initial perceptions of BART might differ depending on this preparatory categorization. Perceptions of BART as a new source of stimuli will be assimilated to perceptions of objects to which BART is taken to be similar. This preliminary categorization provides the individual with a more or less appropriate basis for initially responding to the novel stimuli. If these reactions prove effective, the categorization will be confirmed; if not, it may be changed.

With the accumulation of experience, the concept of BART will become increasingly differentiated, in most cases probably becoming a category on its own, and inputs will then be colored by all of the concepts associated with BART.

> "The study of adaptations to new or modified environments may prove to be more valuable than investigations which begin after adaptations have taken place. Longitudinal studies which trace the sequence of events leading to stable man-environment relationships are costly but necessary." (Wicker, 1974)

The "set" of the receiver affects perception by determining the focus of attention. "Perception is selective, so that we attend at once to only part of the influx of sensory stimulation. Factors of advantage, favoring attention on one pattern of stimuli over another, reside partly in the stimuli

themselves but also on both the habitual and momentary interests of the individual. Preparatory set is one condition for perception" (Hilgard, 1962). McKeachie and Doyle (1966) in defining attention state: "Factors in the environment, such as intensity, contrast, and repetition, and factors inside the organism, such as motivation, determine the aspects of our environment to which we will attend."

Ongoing (brain) activity in the perceiver will influence perception of a "BART stimulus". This is one reason why BART will have different impact during sleep than during waking hours; during work, than during play.

The motives of the perceiver are relevant also. "Only when we order our world with ourselves as part of the ordering transaction, only when our dealings with it are done with a purpose, and only as we relate the environment to our purposes is it truly perceived" (Ittelson, Proshansky, Rivlin and Winkel, 1974).

The highly interactive nature of the person-environment transaction which is involved in BART's impact--in terms of response--is apparent. Perception is the only means of access through which BART can impact persons. However, this "external" zone of the person is in constant communication with, and its functions are strongly affected by, the less peripheral parts of the person.

> "The overall trend of contemporary perceptual studies has been away from the stimulus orientation and toward the treatment of perceiving as an essentially creative process actively carried on by the organism. The assumption is that the individual acts in any situation in terms of the way he perceives that situation. Perception, then, becomes a crucial process intimately involved in the effective functioning of the individual. Such an approach has necessarily led the experimental study of perception into a consideration of problems which had previously been considered a sacred domain of that branch of psychology labeled 'personality'." (Ittelson, 1960)

Phenomenological BART

The Psychological Environment: Life Space: With perception, we enter the phenomenological world which commonly serves as "the environment" in behavioral science research and theory.

> The world as we experience it is the product of perception, not the cause of it, ... within the particular transaction and operating from his own personal behavioral center, each of us through perceiving creates for himself his own psychological environment by attributing certain aspects of his experience to an environment which he believes exists independent of the experience. This characteristic of perception we can label externalization. And (externalized) refers to those aspects of the experience of the perceiver to which he attributes a reality independent of the experience. (Ittelson, 1960)

For Koffka (1935), this is the behavioral environment: "the environment as perceived and reacted to." For Lewin (1936), it is the life space: "the world as a particular person perceives and is otherwise affected by it." Barker (1968) accepts Lewin's definition but prefers the label psychological environment. Kahn and French (1970) accept Barker's label but prefer the definition: "conscious and unconscious representations of the objective world as it exists for the person."

Attitude Defined: Phenomenologically, BART is represented as a cluster of conscious and unconscious concepts, meanings and behavior tendencies within the life-space or psychological environment. This internal representation of BART is the one which defines its impact in personal terms.

Phenomenologically, BART's impact can be described in psychological terms as a complex of attitudes. To give the flavor of the concept, several definitions of attitude follow:

> An attitude is a learned predisposition to respond to an object or class of objects in a consistently favorable or unfavorable way. (Fishbein, 1967)

> Attitudes are likes and dislikes. They are our affinities for and our aversions to situations, objects, persons, groups, or any other identifiable aspects of our environments, including abstract ideas and social policies... have roots in our emotions, in our behavior, and in the social influences upon us. But they also rest upon cognitive foundations. (Bem, 1970)

> An attitude is usually defined by the psychologist as a tendency to respond positively, that is favorably, or negatively, that is unfavorably, to certain objects, persons or situations. (Morgan and King, 1966)

> An attitude is a disposition a person has to favor or not to favor a type of social object or social action... Psychologically, an attitude involves beliefs as well as feelings. (Guilford, 1959)

McKeachie and Doyle (1966) define attitude as: "A configuration or oganization of all of a person's concepts, beliefs, habits and motives associated with an object," and further define the concept in terms of its dimensions:

> Affective component: Two of the dimensions of attitude--intensity and position--refer to the affective component. Position refers to the degree of expectancy of pleasantness or unpleasantness associated with an object. The strength of the affective expectancy is the intensity of the attitude.
>
> Cognitive component: Several attitudinal dimensions are related to the cognitive component. The specificity of the concept of the object is one dimension. (For example, a person may have an attitude toward BART, toward fixed-route mass transit, toward mass transit, or toward transportation systems.) The degree of differentiation of an attitude refers to the number of beliefs and concepts which are associated with the object. (For example, a person who sees and hears BART every day has a much more differentiated complex of attitudes toward BART than does the person who has had little or no experience with it.)
>
> Active component: Attitudes differ in their relation to overt behavior. Some attitudes have many habits associated with them, others have few. Sometimes the only action associated with an attitude is its verbal expression. This verbal expression of an attitude is called an opinion.

Attitude Formation: The formation of attitudes involves the acquisition (learning) of various concepts, beliefs, habits and motives. The affective component--which many consider to be at the core of an attitude--may be associated with any one or several of the many human motives. Katz (1960) suggests that the dynamics of attitude formation and change probably differ for attitudes with different motivational bases. He distinguishes four:

1. utilitarian
2. value-expressive
3. ego-defensive
4. knowledge

An attitude with a utilitarian basis is one that is associated with the survival, safety or some of the social motives of the individual. The object of the attitude (here, BART) is perceived as a goal or as a means to a goal related to such motives. (A resident's favorable attitude toward BART because it will make his commute easier is one example.) A person acquires utilitarian attitudes through experience with the object. The nearer the object, and the less ambiguous the relation between it and motive satisfaction, the stronger the probability of acquiring a favorable attitude. Similarly, the more closely an object is associated with negative effect (late to work on account of BART), the more likely the development of an unfavorable attitude.

A value-expressive attitude is based on a person's motive for self-esteem and self-actualization. Each person comes to identify certain general goals as values and to develop concepts of self-identity and of self-esteem. Those attitudes which express his values and his ego-ideal will enhance his feelings of self-esteem.

The formation of value-expressive attitudes depends on an individual's perception of the relationship between the object, the attitude, and his ideal of himself. (If a person values environmental protection and perceives his use of BART as contributory to that protection, he will tend to have favorable attitudes toward the rapid transit system. Conversely, for a person who values social status, and for whom living "across the tracks" or near them represents low status, attitudes toward having BART in his neighborhood will tend to be negative.)

Ego-defensive attitudes are also related to the motive for self-esteem but they defend the ego rather than promote it. They are formed in conjunction with processes to defend the person from his own anxieties: i.e., the defense mechanisms. (If a person is unable to move away or to provide a barrier which reduces noise from a BART station, he may deny that the noise bothers him despite the fact that it does.)

Attitudes with a knowledge base are acquired in conjunction with competence motives, specifically the motives to acquire a clear, stable, and consistent picture of the world. When a person operating under this motive is confronted with an attitudinal object with which he has had no experience and about which he has little information, such as BART, he will 1) actively seek to obtain information which will lead to attitude formation by one of the principles discussed above (such as seek contact by riding BART, leading to an utilitarian attitude), 2) by adopting toward the object (BART) the attitudes of the people around him, or 3) by adopting toward the object (BART) the attitude that is consistent with the rest of his thinking (for example, taxes should be cut).

Attitude Change: Though it requires a slight digression, it seems appropriate to mention here that describing phenomenal BART in terms of attitude (as attitude is defined in this paper) has the advantage of tapping into a large research literature on attitude change. Insofar as "phenomenal BART" is significantly discrepant from "actual BART", in some instances of public dissatisfaction the appropriate remedial action may be attempts to change attitudes rather than the rapid transit system.

The area of attitude change is of considerable social importance, and psychologists have spent much effort in isolating the variables involved. This research on attitude change is likely to be relevant to BART, since initial reactions may represent generalizations from attitudes formed in the course of experience with less modern rapid transit systems and on the basis of news media presentations and what "everybody says", rather than on the basis of direct experience with the new system.

Changing the Cognitive Components: Frequently, attempts at attitude change take the form of providing new or additional information. Success depends upon several factors:

a) The nature of the message. One-sided communication is most effective in strengthening a person's attitude which is already consonant with the message, but presentation of both sides is more effective in reversing a person's position (Hovland, Lumsdaine, and Sheffield, 1949). Two-sided presentation is also more effective in "innoculating" people against future presentations of the opposing side (Lumsdaine and Janis, 1953), making the new attitude more stable. To be most effective, the message should change the relationship between the object (BART) and the person's goals (Carlson, 1956).

b) Characteristics of the presenter. People's attitudes are most influenced by information attributed to a person of high prestige (Brehm and Cohen, 1962), one they think attractive (Tannenbaum, 1956), or one they like (Back, 1951), and by groups. "Accidentally overheard" messages are more effective than when the person knows an effort is being made to change his attitude (Katz and Lazarsfeld, 1955). A number of studies indicate that personal contact is more effective than media communication.

Changing the Affective Component: Many attempts at attitude change do not deal with a person's information or beliefs about the object, but rather work to associate the object with something pleasant (apparently anything, judging from advertising). The use of fear or threat of danger or punishment to change an attitude may have unexpected results and is not usually useful.

Changing the Action Component: Performance of an action which is contrary to attitudes can lead to attitude change--if the consequence of the action is rewarding and satisfying to the performer. Expression of opinions which are contrary to attitudes may lead to attitude change under certain circumstances:

1. If there is no other simple means for the person to reduce the dissonance created by contradictory beliefs and acts,

2. If the expression is rewarding, and

3. If in the process of formulating arguments to express the new opinion, the person believes he is using his own ideas which augments his feeling of competence. (McKeachie and Doyle, 1966)

In producing attitude change through the action component, group participation is more effective than passive listening when:

1. Participants are encouraged to think about positions opposite their own,

2. Participants are asked to make a public commitment, and

3. Participants perceive consensus among their peers. (McKeachie and Doyle, 1966)

The Salient Intervening Variables

The major purpose of this paper is to specify BART's impact in terms of independent variables, dependent variables, and "intervening variables"--those postulated to operate within the "black box" of the personality (P)--which must be taken into account in order to state and test predictions (hypotheses) regarding the relationships between BART attributes and human behavior. It is necessary, then, to take a closer look at that "black box" of personality which, as we have seen, affects perception of BART and formation of attitudes toward BART, and which likewise determines response to BART.

Definition of the Personality: According to Warren's Dictionary of Psychology (1934), personality is "the integrated organization of all the cognitive, affective, conative, and physical characteristics of an individual as it manifests itself in focal distinctness from others."

> What emerges...out of the continuing interaction of percepts, need states, and feelings are higher-order and more-or-less enduring psychological structures in the form of attitudes, values, interest, self-concepts, personality traits, abilities, and aptitudes. The values, attitudes, and other behavioral dispositions that he carries with him are a consequence of his earliest cultural and social experiences imposed upon his unique biological and physical tendencies... (Ittelson, Proshansky, Rivlin and Winkel, 1974)

Personality is also: "The traits, modes of adjustment, defense mechanisms, and ways of behaving that characterize the individual and his relation to others in his environment" (Morgan and King, 1966).

An Adaptation Model: In psychological terms, "BART impact" can be translated into "adaptation to BART."

> The most pervasive characteristic of biological systems is the principle of adaptation. Essentially this involves the self-regulating tendency of living organisms to maintain themselves by various means of accommodating or adjusting to changes in the environment. (Sells, 1974)

> Adaptive function of an organism...implies the existence of feedback mechanisms. The posture of the organism at any moment is in effect the expression of an intrinsic (and not necessarily consciously experienced) hypothesis concerning the nature of the environment. Every response is similarly an interrogation of the environment and the resulting feedback provides information (also not necessarily conscious) that enables the adaptive response...such mechanisms are essential components of adaptive organisms and...both biologic and molar behavior are controlled by information-processing systems in which anticipation, expectation, posture or set is one fundamental characteristic and adjustment, based on information feedback is another. (Sells, 1974)

And: "Adaptation refers to the responses available for dealing with emergent environmental circumstances" (Emery and Trist, 1973). It is these responses which will, later in the model, provide measures of BART impact. We are concerned, at this point, with the "intervening variables" between stimulus and response, with what goes on inside the "black box" of the personality. The model assumes that perception, inner-person processing, and behavior all serve in the interest of adaptation.

A Congruence Model: Murray's (1938) need-press conceptualization of human behavior incorporates two major dimensions, environmental press and human needs, and postulates that the quality of adjustment is a function of the degree of congruence between the two. The concept of environmental press "provides an external situational counterpart to the internalized personality needs" (Stern, 1974).

Environmental objects or situations give rise to positive or negative "presses" depending on whether those objects or situations facilitate goal achievement or need satisfaction on the part of persons (Murray, 1938). Environmental press is anabolic when comprised of stimuli potentially conducive to self-enhancing growth, cognitive mastery, or adjustment; catabolic when comprised of stimuli involving psychological constraints, antithetical to adjustment and likely to produce countervailing responses (Stern, 1970).

In the present study, the two dimensions of the model are "BART press" and relevant human needs. A given "BART-press" will be positive or negative, depending upon its potential for facilitation or frustration of needs. [1]

Consensual BART

A Practical Argument: It seems appropriate, before going further, to review the requirements for the model in terms of the study purpose. This is not an exploration into individual differences among Bay Area residents, but an investigation of the impact upon them of BART as a feature of the local environment. Even from a basic research viewpoint, as Fredericksen (1974) puts it: "From a scientific rather than a clinical point of view, psychologists are interested in generalizations that hold for a large number of people, rather than for just one individual."

For purposes of the present study, the role of personal traits is even more restricted. A fixed-route transit system is incapable of responding to needs, values, interests, etc. which are idiosyncratic in nature and distri-

[1] The advantage of an adaptation model based on need-press consequence over a stress model is obvious, in that the former accommodates favorable BART impacts as readily as negative impacts.

buted in the population randomly or in any other form of dispersion which cannot be related to geographic or locational parameters. Therefore, it is necessary to deal in a highly selective manner with personality variables, involving only those demonstrably relevant to the study's purpose.

The model, so far, has traced the input from "BART attributes" to "BART stimuli," and to the latter as modified by other features of the physical context, through perception, to what might be called "phenomenal BART"--the perception of BART by individuals.

Lawton (1975) has referred to three levels of environmental definition when one attempts to dimensionalize the environment into higher order abstractions:

1. The phenomenal physical environment--the unique, idiosyncratic experience of a physical object by one individual;

2. The consensual physical environment--while the environmental quality must be experienced by the individual, enough individuals experience the quality in a similar way so as to suggest a convergence on the "real object"; and

3. The explicitly physical environment--qualities that may be measured in "centimeters, grams and seconds."

For purposes of the present model, Lawton's categorization seems applicable to BART. So far, the model has dealt with the "explicitly physical level" in a somewhat more sophisticated way, by 1) detailing "BART attributes" (in order that the study results have specific, practical application), 2) specifying "BART stimuli" (in order to determine the relationships between BART attributes and human response, mediated by sensation), and 3) taking into account the modification of "BART stimuli" by other characteristics of the physical and social environment.

The question, now, is whether either or both of Lawton's other "levels" of environmental definition should be incorporated to define the "internal representation" of BART which all theorists agree is the determinant of behavior. In terms of the study purpose, it seems inappropriate to deal at the highly idiosyncratic phenomenal level. On the other hand, an overall "consensual BART" may cancel out important variations. Perloff (1972) and others have argued persuasively on the necessity for sensitivity to important differences in environmental perceptions and judgments on the part of different types of people. Obviously, the BART studies must take a broad-gauged view. The

The inadequacy of experts' judgments in representing the resident population's views of environmental qualities has been discussed above, for example. Perloff makes the additional point that views regarding environmental quality and environmental impact vary even among "men in the street."

However, Perloff's argument may be taken at the level of population subgroups. Along with Fredericksen, 1974, we suggest:

> There is the possibility that groups of people can be identified that are larger than one, but less than all mankind, whose behavior can be described in terms of particular kinds of relationships between performance and situational variables.

There is little doubt that, in order to account for all of the variance in B in the basic equation B=f(E, P, ExP), individual difference measures at a deeply inner-personal level will be requisite. However, BART design and operation can respond only to "person characteristics" which are common to all people plus those which are general among important population subgroups.

The task, then, is to review the parts of the model in order to specify those which can be considered constant for the "average person" and those which can be further specified for important subgroups, in such a way as to enable prediction from BART stimulus (BART S) to response to BART (BART R) at a level of disaggregation which is of practical use to BART and to the developers of other rapid transit systems. (It will, inevitably, also have implications for theoretical models of environment-person transaction.) This involves specification of those aspects of personality which it seems must be taken into consideration in order that the model will account for meaningful amounts of the variance in the independent variables and yet stay within bounds of the study purpose and the response capability of a fixed-route rapid transit system.

First, consideration will be given to "universals." BART S is measurable, instrumentally or otherwise, in an objective fashion and will not vary significantly for persons with normal sensory equipment. The Gestalt principle of figure and ground depends upon innate neural mechanisms (Koffka, 1935) and, therefore, operates similarly among normal perceivers.

Motives and needs can also be viewed from a generalized viewpoint: All mankind shares the basic needs which are relevant to perception of and reaction to BART. For this purpose it seems appropriate to accept Maslow's (1954)

hierarchical organization of needs. The most basic, which take precedence over all others, are the physiological needs. These are followed, in order of precedence, by needs for safety and security, belonging or social needs, self-esteem, and self-actualization.[1] A somewhat simplified scheme, following Maslow, states the hierarchy in terms of: 1) survival needs, 2) social needs, and 3) ego-integrative needs (Hilgard, 1962).

Congruence and Hypothesis Derivation: The process of adaptation to any BART stimulus may then be stated in terms of the degree of congruence the BART stimulus has with common human needs in each of the categories. This congruence model of BART-person interaction has its roots in Lewin's notion that behavior is a function of the relationship between person and environment, and in Murray's need-press model of human behavior, in which environmental press is a situational counterpart of internalized need, and the outcome depends upon the degree of congruence between the two: the degree to which the environmental press (here, BART stimulus) facilitates or frustrates need-satisfaction. More recently, French, Rogers and Cobb (1974) define adjustment as "goodness of fit" between characteristics of the person and those of his environment.

These authors suggest further that the discrepancy between subjective assessments of the environment and its objective attributes may, in itself, represent an important aspect of congruence (ibid). Stated in terms of Murray's system, this suggests hypotheses regarding the differences between alpha press and beta press; in terms of attitudes, the difference between a BART stimulus and the cognitive aspect of attitudes toward that stimulus.

On a more molar level, hypotheses can be stated with regard to the causal relationship between a BART stimulus and a specified response, in terms of the degree of congruence between the BART stimulus and the hierarchy of human needs. The congruence model has the significant advantage of making possible the simultaneous consideration of various BART impacts. This can be summarized in various ways. One way is to use human need categories as the rubrics, and to categorize BART stimuli accordingly. Another, and probably more useful for purposes of the present study, is to use BART stimuli as the bases for summation. The latter strategy provides more direct attribution of findings to BART attributes and, therefore, makes findings directly applicable to BART policy and planning, and to new rapid transit systems.

[1] Transcendence, a later addition to the Maslow scheme, is not included here.

The congruence approach also provides a basis for the development of an overall model of BART impact which summarizes the impact across BART stimuli and across human needs. For this comprehensive aspect of the model, a weighting system must be developed. Toward a summative score regarding overall BART impact, each component need-stimulus discrepancy will contribute not only in terms of the magnitude of that discrepancy, but also in terms of the precedence of that need in the hierarchy. In other words, discrepancies of similar magnitude will have different consequences if they involve basic vs. higher order needs.

Currently available congruence models have two major drawbacks for present purposes: (1) they tend to concentrate on negative effects and so fail to provide for the real possibility of beneficial BART impacts, and (2) they tend to deal with the environment only at the beta press or within-person level, which is of limited utility for policy and planning purposes.

A review of the literature in 1970 (Wohlwill) showed that congruence models generally deal with potentially negative effects only; and this usually, only in terms of too much stimulation. Essentially, they are stress models. This trend continues in a recent conceptualization of the congruence model (French, Rogers and Cobb, 1974). For purposes of the BART study, catabolic press must be defined not only in terms of low levels of stimulation by noxious BART stimuli (stressors), but also in terms of BART's provision of positive need-satisfiers. More recently, Kahana (1975) proposes a two-directional model. The exact shape of the curve remains to be determined. For example, it may or may not be symmetrical. Evidence does suggest that, for the normal person in the typical situation, the optimal condition is some degree of discrepancy between need and press, rather than total equilibrium (Wohlwill, 1974), so that the apogee will not be at the point of need-press equivalence.

This two-directional model treats environmental press as "too much" or "too little" in relation to personal need. For purposes of the BART study, it will be necessary to specify the conditions in the external world (BART stimuli) which determine "too much", "too little" and "about right." This part of the model remains to be developed.

Kahana's and other congruence models are inappropriate for the BART impact study because they fail to incorporate the physical world of objective reality, the environment "out there", of which BART is a part. In addition, Kahana's model explicitly conceives the person-environment as an idiosyncratic one, specific to each individual. Construction and management of rapid transit systems cannot respond to or be guided by such considerations.

Contextual Considerations: The model remains incomplete in two additional major ways. One is that human needs are in some part situational so that congruence will vary, even for the same individual and the same intensity and quality of BART stimulus, depending upon the situation. Here we come to such concepts as set, ongoing (brain) activity, behavior setting, role, and purpose.

In its pre-BART formulation, the study was oriented only toward the behavior setting (Barker, 1968) of the home. This viewpoint is now expanded to include other behavior settings such as those of work, school, and recreation. Moos (1974), following the social learning perspective developed from the work of Mischel (1968) and Bandura (1969), concludes:

> The social learning theorist takes it as a given that the same people behave substantially differently in different social and physical environments (an assumption that Mischel's excellent review of the literature on the empirical generality of trait dispositions appears to corroborate).

While Barker's concept of behavior setting is an important one, it may not be the most appropriate for the present purpose; each actor in any behavior setting cannot be expected to respond in the same way. In part, this diversity depends upon the role assigned to or assumed by the individual; in Barker's examples of the school room, the stimulus situation will impinge differently upon the teacher as contrasted to the student.

> The study of role... has already forced us to realize that the habit of talking about the stimulus situation, as if an object could be represented by a single formula (of no matter how many dimensions), is false. Rose shows us that the identical physical stimulus object, with very slight changes in the background or general instruction, will be reacted to very differently. (Cattell, 1963)

Hilgard (1962) defines role:

> By analogy with an actor's role, the kind of behavior expected of an individual because of his place within social arrangements, e.g., the male role, the mother's role, the lawyer's role. Any one person fulfills or adopts numerous roles on varied occasions.

Behavior setting and role are both relevant to the matter of purposes and intentions. As Ittelson (1960) has pointed out: "...the study of perceptual correspondence...requires a consideration of the purposes of the perceiver. For the significance we encounter in the course of acting can only be evaluated in terms of what we intend to do..."

Even within roles--or perhaps as a better means of defining roles--is the matter of ongoing activity.

> The occurrence of a potentially stress-inducing condition is always a temporally localized event within an ongoing organism-behavior-environment context; its meaning and the response to it depend in part on what had been ongoing. The temporally simultaneously surrounding context must be taken into account in understanding the occurrence, effects and consequences of stress. (Weick, 1968)

The pre-BART data provide a good example. Reactions to noise varied widely by time of day, suggesting that sounds have quite different connotations if they occur when one is trying to sleep, for example, than during hours of activity. It will be necessary, therefore, to define the factors to use as measures of set[1] to perceive the BART stimulus. This is requisite in order that environmental press-human need congruence can be posited more specifically for purposes of hypothesis statement.

The contractor may decide that categorization of environments in terms of something like Barker's behavior settings may be sufficient or that specification of roles and/or activities is more appropriate.

A promising solution may be to redefine the behavior-setting in terms of primary activities, and to judge congruence on the basis of BART's frustration-satisfaction of the basic needs which underlie these activities, weighted according to their position in the need hierarchy. For example, sleep is a major activity (at least in terms of time investment) in the behavior-setting of the home, but it is irrelevant to the behavior-setting

[1] Set: "A readiness to act in a certain way when confronted with a problem or stimulus situation" (Morgan and King, 1966).

of work. Reading, on the other hand, is a normal activity in both behavior settings. The congruence of BART press and human needs could thus be developed in terms of a profile of activities. Overall impact could be viewed by summing the need-press congruence across activities, weighting each by the hierarchical position of the need involved.

Coping Ability: The model remains deficient of one more "intervening variable" which must be included if the S-R relationship is to interpreted in terms of human adjustment or adaptation, and which can be included without resort to the intensely idiosyncratic personality dimensions whose measurement would be prohibitively time-consuming and costly, and whose functions would not be useful in the present endeavor.

The nature and quality of adaptation to BART stimuli will depend in some part upon the adaptive competency of the person or, conversely, upon his vulnerability to environmental presses. Since "coping" is the major "intervening variable", some estimate of coping ability should be included in the model. This seems possible through developing indexes of competency/vulnerability based on personal statuses, supra-personal statuses, and non-BART environmental press.

Personal Statuses: P (person) processes which seem to be most clearly relevant to adaptive capacity are health, perceptual-motor, cognitive and ego-strength statuses. For purposes of the present study, these might be estimated by interview questions on health and physical problems, education, and feeling of powerfulness-powerlessness. For some types of BART stimuli, an additional item regarding specific sensitivity or vulnerability might be included (as, for example, self-perception of sensitivity to noise or to inhalants).

Supra-personal or Social Statuses: In a social structure, status is "a position representing differences that are important in the exchange of goods and services and in the satisfaction of needs in a society" (Morgan and King, 1966). The poor, members of ethnic minorities, the aged, and other population subgroups have less resource for making adaptive responses, either by avoiding or reducing negative influences in the environment, or by having access to potential need-satisfiers. For example, in situations in which the sound level of BART becomes "noise", members of these groups have less capacity either to escape or to defend themselves. Furthermore, according to Lawton's and Simon's (1968) "environmental docility hypothesis", the behavior of the relatively incompetent is determined to a greater degree by the environment (E) and less by person (P) traits.

Therefore, the vulnerable will be more strongly affected by negative BART impacts and, according to the same hypothesis, they may most greatly benefit from BART-generated improvements in the environment.

Extra-BART Environmental Press: Vulnerability to BART stimuli is obviously, in part, a function of the remainder of the environmental press. For example, persons in well-constructed buildings with tight-fitting doors and windows, and air conditioning, will actually have a lower level of BART sound impinge upon them (unless sound measures are taken inside structures).

Furthermore, the model follows multiple-stress theory (Selye, 1956) and psychodynamic theory more generally (see for example, Fenichel, 1945; Blum, 1953; White, 1974) in assuming that the impact of BART will be determined, in part, by the satisfaction-stress balance of the total environment press of which it is a part. To estimate this part of the model, census figures on adequacy of housing (crowding, average dollar value, units lacking plumbing, etc.) and on social aspects of the local area (such as % female heads of household, % 65+, average income, % black, etc.) should be included as well as figures on crime in the local area. In addition, potential stressors such as number of freeways, railroads and arterials in the area, and distance from each should be added. (Pre-BART data suggest freeways as stressors rather than satisfiers, at least in the residential setting. Access to freeway was in last place when residents rated desirability of various facilities "near home.")

The Competence-Press Model: These various types of competency-vulnerability items, incorporated, can provide one axis of an adaptation model. The other axis may comprise the discrepancy between BART press and human needs. When BART press is appropriately congruent with need and coping ability is high, adaptation will be easy, and experience and behavior will be favorable for the internal economy of persons and adient (favorable) toward BART. As the discrepancy between BART press and human need increases, and coping ability decreases, adaptation will be more difficult, stress will be experienced, and response will be increasingly maladaptive in terms of interpersonal functioning and increasingly avoidant (negative) toward BART.

Stress has been defined as "the result of imbalance between the perceived environmental demand and the perceived response capability" (McGrath, 1970); and environmental conditions are usually referred to as stressors when they are "abnormal or extreme" (Griffitt and Veitch, 1974). The present model substitutes objective items for perceived ones, since BART design and operation must deal with alpha press (the world as it is) rather than with beta press (the world as an individual perceives it).

Investigations of the influence of environmental conditions (such as temperature, noise, lack of sleep, vibration, etc.) typically have been carried out under laboratory conditions and have involved response variables such as vigilance, pursuit tracking and serial rote learning.

> In light of growing concern over environmental influences on nonperformance and nonintellectual behaviors, systematic knowledge concerning the role of environmental conditions with respect to social behavior will assume crucial importance as variables such as noise level and population density reach the status of stressors in years to come. (Griffitt and Veitch, 1974)

These authors cite, for example, recent evidence regarding the role of environmental stressors in urban riots. However, on the basis of a thorough literature review (Griffitt, 1969), Griffitt and Veitch (1974) conclude that there is a "dearth of systematic studies of environmental influences on human social, affective, and emotional behaviors."

The terms in the model will vary, of course, according to the specific BART stimulus under consideration, in order that the findings have direct and practical applicability back to BART attributes. This approach also allows for the preparation of a general model which combines the various submodels into an overall impact statement regarding BART. It is by no means necessary or even likely that adaptations to the various BART stimuli will be similar, even for persons with identical competency-vulnerability. Different needs will be involved in determining the population need-BART press congruence, and different competencies will be involved for various BART categories (though it is likely that there will be a "general factor" of competence-vulnerability). This approach also allows for testing the relative importance or salience of various BART presses, and determining the degree to which favorable responses counterbalance or compensate for negative ones, in terms of overall impact.

However, at the present stage of their development, competency-press models are also deficient, for purposes of the BART study. BART stimuli will be measured instrumentally or otherwise in an objective way to provide scores ranging in intensity, degree or amount. However, these scales of least-most or lowest-highest do not relate in a simple fashion to the dimension of environmental press. In the first place, environmental press according to Murray can be catabolic as well as anaclitic. Actually, this is one of the major advantages of Murray's scheme in regard to the present study:

BART may have favorable as well as unfavorable impacts upon people. The model must provide for this possibility, and for the trade-offs between positive and negative effects as well as the cumulative effects of multiple stressors and of multiple gratifiers. Unfortunately, for the present purpose, most man-environment models include only the anabolic side and view environmental impacts solely or primarily in terms of degree of stress.

If consideration were to be only of BART stimuli which are potential stressors, the task would be relatively simple. For example, following Lawton (1975), the axes of personal competence and intensity of BART stimuli could be used to generate predictions regarding adaptive outcome. While the concept underlying these models is relevant, as is that underlying the congruence models, they are not sufficient for the BART study, primarily because none as yet confronts the consequences of favorable effects other than in terms of low levels of potentially stressful stimuli. Need-satisfaction is actually dealt with in terms of tension-reduction only in its defensive sense.

To define environmental press in terms of intensity--weak to strong--has the favorable effect of making this dimension measurable in objective alpha press terms which are also apparently comparable across types of BART impact. However, regardless of individual differences in coping ability, "weak" air pollution is not likely to result in negative affect or maladaptive behavior. Neither is "weak" sound level, particularly during sleep hours; nor "weak" intrusion into the privacy of homes. And, if an objective measure of BART's appearance is developed, surely no one would expect the "very beautiful" sites to have consequences similar to those "very ugly."

Furthermore, these models do not specify input, intervening or output variables in sufficient detail to be immediately applicable to the BART study. Finally, though all pay lip-service to transactionalism, these latest generation person-environment models are not fully transactional as yet. They tend to be functionalist in orientation, in that they relate to adaptation. However, the stance is sometimes almost behavioristic, in the uni-directional emphasis on what E does to P. They do not speak to the dynamic "field" situation of the Bay Area population in interaction with BART, while both population and rapid transit system are embedded in a dynamic physical-social environment, all elements of which have interplay with each other as well as with BART and the population.

In addition, to define environmental press only in terms of intensity--weak to strong--has the signal disadvantage, for present purposes, of limiting cumulative effects to negative BART impacts. A major hypothesis to be

tested is that positive impacts offset negative ones. For example, presence of a desirable strip park may blunt negative reactions to train noise or privacy invasion. Moreover, the moderating effect may depend partly upon the nature and number of human needs involved. For example, BART's utility and convenience as transportation may profoundly and pervasively influence evaluations of BART's environmental impacts. This expectation derives from the wide range of human needs, throughout the hierarchy from basic life-maintenance to self-actualization, whose satisfaction is dependent upon transportation. Furthermore, since a job is necessary to the fulfillment of the most basic needs and to a wide variety of needs, use of BART for the work commute must be expected to most powerfully color evaluations of all aspects of the impact of the rapid transit system.

Dependent Variables: Behavior

"Phenomenal BART impact" has been defined in terms of attitude formation; and attitude, as a "psychological readiness to act in a particular way" (Morgan and King, 1966). For purposes of practical application, the model for the present study must now be tied at the outcome end, as at the input end, to measurable variables "outside the skin" of the respondent. The dependent variable[1] for each hypothesis must be an overt expression of some aspect of "phenomenal BART impact." In the ecological form of Lewin's basic formula, these must, then, be directly observable behaviors (B). For this purpose and in line with the functionalist orientation, Hilgard's (1962) definition of behavior is accepted: "Those activities of an organism that can be observed by another organism or by an experimenter's instruments. Included within behavior are verbal reports made about subjective, conscious experience."

Measurement of Attitudes: Response to questionnaire items is a suitable compromise between actual attitude, which is inaccessible to study, and perception of the requirements of the immediate situation. Attitude scales determine a person's position on an attitude by viewing his acceptance or rejection of relevant statements. Sometimes these statements directly reflect the affective component ("The Bay tube frightens me"). Sometimes they reflect the cognitive component ("I believe BART will reduce air pollution"). Sometimes they reflect the action component ("I expect to take BART to work"). All these components can be included in measures used to determine attitude toward BART. The basic assumption is that there is consistency among the motives, beliefs and habits that are associated with a single attitude object (such as BART).

[1] Dependent variable: "The variable that changes as a result of changes in the independent variable" (Morgan and King, 1966).

A more direct way to measure the action component of an attitude is to observe the behavior of a person toward the object of the attitude (riding BART) or traces of that behavior (drawn window shades on the BART side of houses).

Centrality-Peripherality of Attitudes: Some attitudes have little effect on a person's thinking and behavior; others have a major effect, in a wide variety of situations. The greater the effect of an attitude upon a person's psychological processes and behavior, the more "central" it is said to be. The degree of centrality depends upon the strength of the motive which is associated with the object, and it also depends upon how persistently the object is present in the person's environment.

Consistency Among Attitude Components: Verbal report and action do not always agree. Campbell (1963) has demonstrated that this does not necessarily convey inconsistency within the attitude, particularly in view of the unidirectionality of the discrepancies which have been observed. Rather, the difference between verbal report and action in regard to an attitude object may be taken as an index of attitude strength. For example, we can think of varying degrees of the attitude that BART is deleterious to residential areas, then examine situations in which it would be easier and harder to express the attitude in action. (For example, trying to sell one's home near BART vs. negotiating a new tax value for it vs. complaining to like-minded neighbors.) The more difficult the situation, the more extreme the attitude must be in order to be expressed in action. Recent research (Wicker, 1974) suggests that people's judgments about how they would respond in situations are consistently better predictors of actual behavior than are their ratings of how much they like or how they perceive those same situations. This suggestion is relevant to the format of interview items to assess attitudes toward BART.

Valence of Attitudes: The interactions among need, environmental press and coping ability will produce attitudes which range from negative through neutral to positive. They may be directed toward or affect any part of the model: BART, the physical context, the social context, or the respondent. They may be expressed spontaneously or may need to be elicited for measurement (Green, 1954).

To the extent that BART facilitates need satisfaction, the results will be favorable for adjustment, and behaviors and attitudes (behavior readinesses) will be positive. To the extent that BART frustrates need fulfillment within the coping ability of the respondent, outcomes will be maladjustive. Congruence, then, will result in active coping, adjustive response, satisfaction,

acceptance, and adient behavior toward BART. Incongruence will result in avoidance of BART, dissatisfaction with it, and possibly even aggression against it. This may be expressed directly against BART in terms of avoidant (moving away, erecting fences) or destructive actions (ranging from vandalism to votes) and in negative verbal statements. Through displacement it may be directed at other elements of the physical environment and/or at persons (supra-personal environment) or social institutions. If need frustration is extreme enough to threaten the self-concept, the attitude may be repressed and become unconscious. As a consequence, it will be inaccessible through verbal report, though it may be evidenced in other behavior (Fenichel, 1945). Repression in defense will occur more often among vulnerable people who are powerless to escape from or directly defend themselves against a negative impact.

Strongly negative attitudes may be expressed in macro-behavioral terms of avoidance by moving the place of residence, work or recreation away from BART. Confronted with any noxious stimulation from which it cannot escape, the organism attempts to cope by using some form of defense. This might take the form of environmental alteration (such as locking doors, closing windows, planting shrubs) or behavioral adjustment (such as changed use of living or working space). If the person is unable to "flee or fight", the result may be continued frustration which leads to aggression (Miller and Dollard, 1941) or to surface resolution of the frustration and reduction of the cognitive dissonance (Abelson, Aronson, McGuire, Newcomb, Rosenberg, Tannenbaum, 1968) by repression.

For example, the tendency of poor, elderly persons to express satisfaction with miserable living conditions has been noted by many investigators. Recent evidence suggests their response is dissonance reductive rather than value expressive (Carp, 1975). Evaluations were sharply and consistently affected by notification of acceptance for new housing. Those notified favorably changed their evaluations of current housing in a clearly negative direction; evaluations of those not offered better housing did not change.

This "forced adaptation" occurs at some cost to the individual.

> The question arises...whether in spite of the individual's capacity to adapt to an astonishingly wide range of environmental conditions, such prolonged exposure...may not leave its mark nevertheless. That is, it is possible that the arousal value or the subjective evaluation of the stimulus environment by the individual may become assimilated to

> some normal range, and his behavior become effectively adapted to it; yet more subtle long-term effects on behavior may nevertheless occur...the cumulative effect...may still leave a residue detectable in his behavior, which might take the form of heightened arousal thresholds, lessened frustration tolerance, or the like, representing the price being paid for his surface adaptation... (Wohlwill, 1974)

Here, the impact of BART may feed back to the Bay Area situation in two ways: by increasing the level of stress in the urban environment, and by reducing the overall competence level of affected persons. In both ways, negative BART impacts may be reflected in general social indicators such as crime and health records.

Shutting out of input due to the necessity of psychological defense has immediate as well as developmental implications. Those who are unable to "leave the field" or adequately to defend themselves against negative impacts, and who must, therefore, internalize the conflict by suppression or repression, will be less aware or conscious of those negative impacts. This provides for additional hypothesis testing: those low on the overall competence-vulnerability scale (or specific subgroups such as the elderly or poor) will express less awareness of negative stimuli in verbal statements about BART.

The Final Feedback

Obviously, BART impact defined in person terms has consequences for all other elements in the model as well. In principle, the transactional viewpoint accommodates this fact: "The traditional conception of a fixed environment to which organisms must adapt or perish is replaced by the ecological view that emphasizes the organism's role in creating his own environment" (Ittelson, Proshansky, Rivlin and Winkel, 1974). However, in terms of study design there are many problems.

It might be summarized that the impact of BART on P can be measured at several levels: physiological (blood pressure, heart rate), psychological (attitudes, behavior readiness) or motor (overt behavior). These can be measured "at the person" by instrumental or observational measures of spontaneous (blood pressure reading, moving toward or away from BART), or elicited responses (attitude-scale scores), or by behavior traces (closed window shades, graffiti, elected officials). In terms of P, BART impact may be favorable, neutral or negative at each level.

However, the matter does not stop there. Each type of P response will feed back to other parts of the system. While these feedbacks will also be +, 0 and -, the valences for any one may differ between P and other elements of the system. For example, moving may be adaptive to P but detrimental to Supra-personal Environment; not-moving may be maladaptive to P while being either beneficial or detrimental to Physical and Supra-personal Environments.

IV. A PRACTICAL PRELIMINARY MODEL

Limits: The Transactional State-of-the-Art

The incredible complexity of any model which will deal thoroughly as well as systematically with BART's impacts has been readily apparent throughout. The dynamic and interlacing nature of the person-environment interaction is, no doubt, adequate explanation for the dearth of ready-made theories from which a BART-impact model can be selected. The assignment for this paper was to search behavioral science and particularly environmental-psychology literature for the most appropriate theoretical background. A fairly comprehensive search suggests that no theoretical formulation has yet been developed to the point of utility for the present purpose.

The BART study may well make theoretical advances for the field of environmental psychology, and for the methodology of environmental impact studies in general, by awareness of attempts to conceptualize the PE interaction involved in BART's impact upon the environment. However, it must be kept in mind that this is not "basic research"; it is a study aimed at specific and practical application. Therefore, while the study should be carried forward in light of the most recent attempts at theory-building, it should set forth as its procedural framework a conceptual model along greatly simplified lines.

A good place to start is sometimes at the end. That may be true in the present case.

Dependent Variables: Attitudes

From the plethora of potential indicators of BART impact (which have been alluded to only briefly and in categorical terms in this paper, for obvious reasons), those germane to this study should be selected. The selection process should include among its criteria: (1) the mandates of other BART studies (for example, land use, automobile traffic, BART usage and retail sales); (2) the cost and quality of the necessary data (for example, individual medical or psychological examinations are clearly prohibitive in price; and the variation in techniques of collecting and maintaining health and crime statistics, from jurisdiction to jurisdiction, raises questions regarding their utility for the present purpose); (3) the amplitude of the expected impact in terms of instruments available to measure it (it seems unlikely that physiological impacts will be sufficiently large and widespread to show up in public health records); (4) the adequacy of controls to allow attribution of a given

change to BART as its cause (which is a particular problem with secondary effects); and (5), perhaps most important of all, the utility of the finding (which generally sums to its practical relevance to BART, to other public policies and programs in the Bay Area and to planners elsewhere). The preeminent criterion for selecting dependent variables should be utility to policymakers.

Attitudes (toward BART and toward qualities of the environment impacted by BART) are the dependent variables of central interest. These attitudes may be measured in terms of verbal response to questionnaire items, behavior observations and behavior-trace records. Behavior and behavior-trace observations should be conducted in the same geographic areas as the interviews and, so far as possible, the actors defined in terms of statuses (age, sex, physical handicap, etc.), to facilitate integration of data from the various sources.

Attitudes toward BART as expressed in interviews should be factored or otherwise analyzed into salient dimensions of human response. Similar analysis should be done of behavior and behavior-trace records. The resulting factors will be dependent variables for direct human response. Individual respondents can be scored for each of the former by applying loadings on the factors; areas can be similarly scored for interview factors and for behavior and behavior-trace factors.

Independent Variables: BART Attributes

Now, back to the beginning, the independent variables. For the part of the study which involves human response, it remains necessary to define the stimulus properties of BART in terms of the human sensorium. Each BART stimulus must be measured by instrumental or other objective means to produce quantitative stimulus dimensions (at least in terms of more/less, if not more precisely). Without this type of dimensionality for the stimulus variables, it will not be possible to ascertain their relationships with dependent variables of any sort.

So that the results can have policy relevance, each BART stimulus must be analyzed as the outcome of specific and measurable BART attributes (track curvature, train speed, maintenance, elevation, etc.).

Physical Moderators of BART Stimuli

In order to avoid confounding the effects of the physical context with those of BART, and to enlighten policy decisions, the interactions of characteristics of BART with those of the environmental setting must be determined, as must any change in a BART stimulus which is the result of the physical context. (Regression and factor analyses are useful statistical tools for this purpose.)

Other Physical Characteristics of the Context

Aspects of the physical environment which do not directly change the intensity of a BART stimulus but which may affect human response (substandard housing, crowding, other noise sources, etc.) should be (factor) analyzed to determine the major dimensions of variance.

The Supra-personal Environment

Meantime, census-type figures descriptive of the major ways in which the Bay Area population varies should be (factor) analyzed to determine the major dimensions of this variance.

The Physical Supra-personal Environment

The physical and population variables should be viewed conjointly to describe the BART context. It will be useful to analyze these variables together, and to consider the adoption of the resultant joint factors as the descriptors of BART context.

Mapping BART in Context: Sampling Strategy for Human Response

A map of the Bay Area might now be made which would show the distribution of BART stimuli (after their modification by barriers, etc.), along with the distributions of the contextual factors. On the basis of this information, a strategy can be developed for selecting geographic areas which represent the range of the major variables involved in BART-stimulus-in-context. If financially feasible, this strategy should select areas to represent the entire range of values, not just the extremes. Ranges are preferable to extremes, in view of the largely unknown "shapes" of the curves representing relationships, and the very real possibility that some attitudinal measures will show curvilinear relationships with BART stimuli, due to the resolution of cognitive dissonance through denial or displacement.

Person Variables

Every effort (including adequate callbacks, community involvement and payment to respondents) should be made to insure collection of interview data from random samples within the geographic areas specified for data collection. Any other approach to representativeness, for areas selected in this manner, is inappropriate because of the lack of sampling frames. In addition to the items which will serve as dependent variables (indexes of BART impact), data on relevant statuses should be recorded for each respondent (age, sex, health, socioeconomic, ethnic, education, etc.), to serve as one set of potential moderator variables.

It remains for other studies to ascertain the role of individual differences in personality variables in regard to attitudes toward BART and environmental qualities. This is an important and fascinating area. However, the objective of this study rules out inclusion of individual difference measures, since there is no way in which BART or any other fixed-route mass transit system can respond to idiosyncratic traits distributed in the population without relationship to geographic location or identifiable subgroup membership.

Behavior Setting or Activity Role

It is important to include some index of the setting in which or about which the respondent is interviewed, since BART's impact will vary from work to home to school, as well as from actor to actor in any one place. Pre-BART data demonstrate clearly that environmental impacts (such as noise) vary according to the time of day and according to the activity the person is performing.

The first issue is to settle on the level of detail which it is possible to include. At the very least, there should be distinction among such macro-differences as residence, work, and place of recreation outside home.

This can be incorporated into the system either by (1) putting this variable also on the map, and including it in the sampling strategy considerations, or (2) adding it to the questionnaire so that it will be in the data file for subsequent processing.

Assessing BART's Impact

Using the ecological modification of Lewin's basic hypothesis, BART impacts can now be tested in two ways: through the correspondence of variance in BART stimuli with that in the dependent variables, and through comparison of data from BART and control sites (and hypothetical comparison with the NoBART alternative).

For the former procedure, the suggested strategy is to see how much of the variance in human response is accounted for by the BART stimulus alone, and how much more is accounted for by each of the other types of data, taken singly and in various combinations. This is essentially a stepwise multiple regression analysis of variance model (unless pre-post change is at issue, in which case it is an analysis of covariance model).

The first step is to correlate dependent and independent variables, ascertaining the proportion of variance in human response (attitude) which is accounted for by the BART stimulus (as measured objectively). Subsequent steps add to the "predictor side" of the equation each set of factors or dimensions (physical environmental context, supra-personal context, behavior setting, and person descriptors) individually and in all possible combinations including the "full set" of all available "predictor" (independent and modifier) variables. It will also be useful to arrange the analysis so that the contributions of individual items within each predictor subset can be discerned. In this way, duplicating or nonpredictive items can be identified.

An alternative procedure which produces identical results is to begin with the "full set" of predictors, determine the amount of variance in the dependent variable for which they account, and then systematically subtract subsets to see the reduction in amount of variance accounted for.

Results

The results will provide the answer to the basic question of the study: what are BART's impacts in terms of human response? It will allow specification of them in terms of population subgroups. It will avoid attributing to BART the effects of other environmental factors. It will allow full examination of the many types of interaction which obviously are of great importance in the real world as well as in the transactional view of it.

This strategy will provide information about (1) the extent to which human response can be directly predicted from BART stimuli, and (2) the extent to which prediction can be improved by adding factors in the physical and social surround, behavior settings, social statuses, and person descriptors. Trade-offs can then be considered realistically, regarding future collection of the various types of data, in terms of the gain in predictive efficiency (percentage of variance accounted for).

There is little doubt that this model is an excellent "fit" to the task at hand. However, some may "put it down" on grounds it is "just empirical." To this there are at least two excellent ripostes. First, at the present state-of-the-art in this area, empiricism seems to be badly needed. Theory development can proceed only in tandem with facts. Second, the model derives from a respectable theoretical background. Third, it involves several levels of hypothesis testing. At the most primitive level, every item which is entered into the "predictor side" gets there only as the result of the statement of an hypothesis. The relationship of that variable to the dependent variable must be supported by previous research or by some other line of evidence.

The basic general hypothesis is that objective measures of BART stimuli are lawfully related to, and predictive of, BART impact as defined in terms of human experience and behavior (attitudes). The direction of the relationship between the less-more dimension of a given BART stimuli and the favorable-unfavorable dimension of the relevant human response measure may be positive or negative. Directionality should be predicted, in advance, in hypothesis statements regarding each BART stimuli-human response pairing.

Furthermore, the shape of the curve representing the relationship between BART stimulus and a human response will vary. For example, it is known that, below a given decibel level, sound is not heard by the normal human ear; and that, above a given decibel level, "sound" becomes "noise" and, increasingly, a stressor (eventually entailing physiological as well as psychological damage). At a low but perceptible level, sound may be favorably perceived as adding interest. On the other hand, matters of safety and security, air quality, privacy, and others, are likely to exhibit more simple relationships between objective measures and human response.

In each case, the first step will be to determine the accuracy with which the BART stimulus "predicts" the relevant human response (attitude); and then to add the other categories of variables, one at a time, and also in all possible combinations, to the "predictor side" of the equation, and to deter-

mine whether each addition significantly improves "predictive efficiency." At each step in this analysis, the new variance is compared with the last variance to answer the question; does adding, for example, supra-personal environment to the set of predictors improve significantly the amount of variance in the attitude under study which is accounted for? Alternately, if the first step uses the full set of predictors, each subsequent step subtracts a subset of predictor variables, and the question is whether the reduction in variance accounted for is statistically significant and meaningfully large.

The results of data processing will demonstrate the validity of each hypothesis by showing the role and potency of each independent (BART stimulus) contextual (physical and supra-personal environments, behavior setting) and person variable. Furthermore, the data can be used to test some of the more sophisticated hypotheses suggested by attempts at theory-building discussed earlier in this paper. To what extent this type of effort is appropriate to work under the contract, and to what extent data should be made available to others for this purpose is a matter to be decided.

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ENVIRONMENT PROJECT PHASE I DOCUMENTATION

- Interpretive Summary*
- Environmental Impacts of BART*
  Interim Service Findings (1976)
- Accessibility Impacts of BART*
  Interim Service Findings (1976)
- Impacts of BART on Air Quality*
  Interim Service Findings (1976)
- Impacts of BART on the Natural Environment*
  Interim Service Findings (1976)
- Impacts of BART on the Social Environment*
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- Library Background for Study of BART's Impacts*
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- Pre-BART Data Analysis*
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- Community Monitoring*
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- BART and Its Environment: Descriptive Data
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- Research Plan*
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